What is claimed is

1. An encoding method of deformation information of a 3-Dimensional (3D) object, in which information on vertices forming the shape of the 3D object is described by a key framing method for performing deformation of the 3D object, the encoding method comprising steps of:

(a) extracting keys indicating positions of key frames on a time axis, key values indicating characteristics information of key frames, and relation information, by parsing node information of the 3D object;

(b) generating vertex connectivity information from the related information;

(c) generating differential values for each of the keys from which temporal data redundancy is to be removed, and key values from which spatiotemporal data redundancy is to be removed, based on the vertex connectivity information;

(d) quantizing the differential values; and

(e) removing redundancy among bits and generating compressed bit stream through entropy encoding, by receiving the quantized keys and key values.

2. The encoding method of claim 1, wherein in step (a) node information is divided into a Coordinate Interpolator (CI) node and an IndexFaceSet (IFS) node, and field data formed with keys and key values are extracted from the CI node and Coordinate Index (CIdx) field data is extracted from the IFS node

3. The encoding method of claim 2, wherein in step (b) the CIdx field data extracted from the IFS node is received as the related information and Breadth First Search (BFS) information for defining spatial data correlation among vertices is formed as the vertex connectivity information.

4. The encoding method of claim 3, wherein in step (b) the CIdx field data is received and stored in a queue for each vertex, and the BFS information is generated based on whether or not each vertex is visited through the queue.

5. The encoding method of claim 1, wherein the step (c) further comprises the steps of:

(c1) receiving the vertex connectivity information, coordinate information of the IFS node as the related information, and key values, and generating differential values among all position values of the key values change in a 3D space;

(c2) extracting data redundancy in the differential values according to the spatial correlation among vertices based on the vertex connectivity information; and

(c3) Differential Pulse Code Modulation (DPCM) processing each of the keys extracted in step (a), and key values of which data redundancy due to the spatial correlation is extracted.

6. The encoding method of claim 5, wherein the number of key data items to be encoded and the total number of vertices in the IFS parsed from the node information as the related information are calculated and using the result of the calculation, differential values of key values are calculated.

7. The encoding method of claim 5, wherein in step (c2) vertices are visited according to the search order of the vertex connectivity information, vertices adjacent to a visited vertex are defined, a vertex having high spatial correlation with the visited vertex is defined as a top vertex, the differential value of the 3D space position values of the two vertices is calculated, and the data redundancy is removed.

8. The encoding method of claim 1 wherein in the step (e) redundancy among bits is removed with respect to the probability of symbol occurrence.

9. The encoding method of claim 8, wherein a bit stream obtained the encoding method is formed at least with encoded key information and key value information, the key information is formed with a combination of the keys and key indicators for the keys, the key value information is arranged in order of key in a key frame, and key frames are formed according to the search order of the vertex connectivity information.

10. An encoding method of deformation information of a 3-Dimensional (3D) object, in which information on vertices forming the shape of the 3D object is described by a key framing method for performing deformation of the 3D object, the encoding method comprising steps of:

(a) extracting keys indicating position of key frames on a time axis, key values indicating characteristics information of key frames, and relation information, by parsing node information of the 3D object;

(b) generating vertex connectivity information from the related information;

(c) quantizing the keys and key values;

(d) generating differential values of each of keys of which temporal data redundancy is to be removed, and quantized key values of which spatiotemporal data redundancy is to be removed, based on the vertex connectivity information; and

(e) removing redundancy among bits and generating compressed bit stream through entropy encoding, by receiving the differential values.

11. The encoding method of claim 10, wherein in step (a) node information is divided to a Coordinate Interpolator (CI) node and an IndexFaceSet (IFS) node, and field data formed with keys and key values are extracted from the CI node and Coordinate Index (CIdx) field data is extracted from the IFS node

12. The encoding method of claim 10, wherein in step (b) the CIdx field data extracted from the IFS node is received as the related information and Breadth First Search (BFS) information for defining spatial data correlation among vertices is formed as the vertex connectivity information.

13. The encoding method of claim 12, wherein in step (b) the CIdx field data is received and stored in a queue for each vertex, and the BFS information is generated based on whether or not each vertex is visited through the queue.

14. The encoding method of claim 10, wherein the step (d) further comprises the steps of:

(d1) receiving the vertex connectivity information, coordinate information of the IFS node as the related information, and key values, and generating differential values among all position values of the key values change in a 3D space;

(d2) extracting data redundancy in the differential values according to the spatial correlation among vertices based on the vertex connectivity information; and

(d3) Differential Pulse Code Modulation (DPCM) processing each of the keys extracted in step (a), and key values of which data redundancy due to the spatial correlation is extracted.

15. The encoding method of claim 10, wherein a bit stream obtained the encoding method is formed at least with encoded key information and key value information, the key information is formed with a combination of the keys and the key indicators for keys, the key value information is arranged in order of key in a key frame, and key frames are formed according to the search order of the vertex connectivity information.

16. An encoding method of deformation information of a 3-Dimensional (3D) object, in which information on vertices forming the shape of the 3D object is encoded by a key framing method for performing deformation of the 3D object, the encoding method comprising steps of:

(a) extracting keys indicating position of key frames on a time axis, key values indicating characteristics information of key frames, and relation information, by parsing node information of the 3D object;

(b) generating search start information of a Breadth First Search (BFS) for defining spatial data correlation among vertices of the 3D object;

(c) generating vertex connectivity information from the related information extracted in step (a) and the search start information generated in step (b);

(d) generating differential values of each key from which temporal data redundancy is removed, and key values from which spatiotemporal data redundancy is removed, based on the vertex connectivity information;

(e) quantizing the differential values;

(f) receiving the quantized keys and key values, and generating the quantization step of encoding bits of the key values; and

(g) receiving the quantization steps of encoding bits and removing redundancy among bits in the quantized values.

17. The encoding method of claim 16, wherein in step (a) node information is divided into a Coordinate Interpolator (CI) node and an IndexFaceSet (IFS) node, and field data formed with keys and key values is extracted from the CI node and Coordinate Index (CIdx) field data is extracted from the IFS node

18. The encoding method of claim 16, wherein step (b) comprises the steps of:

(b1) obtaining the number of vertices connected to each of the vertices in response to connection information among vertices to be encoded;

(b2) obtaining the index of a vertex which has the largest number of connected vertices among the numbers of vertices; and

(b3) generating the vertex of the obtained index as the search start information.

19. The encoding method of claim 16, wherein step (f) comprises the steps of:

(f1) comparing a maximum value and a minimum value for each of the X, Y, and Z coordinates forming the quantized key values;

(f2) if the absolute value of the minimum value is less than or equal to the maximum value in each of the X, Y, and Z coordinates, outputting the quantization step of encoding bits as ;

(f3) if the absolute value of the minimum value is greater than the maximum value in each of the X, Y, and Z coordinates, outputting the quantization step of encoding bits as .

20. The encoding method of claim 16, wherein in step (g) redundancy among bits is removed with respect to the probability of symbol occurrence.

21. The encoding method of claim 16, wherein the bit stream obtained by the encoding method comprises:

header information having the quantization size of the key values, the quantization step of encoding bits of X coordinates of the key values, the quantization step of encoding bits of Y coordinates of the key values, the quantization step of encoding bits of Z coordinates of the key values, the minimum values and maximum values which are used in normalizing differential values from the quantized keys and key values and values between 0 and 1 inclusive; and

key value information according to the BFS search order.

22. An encoding method of deformation information of a 3-Dimensional (3D) object, in which information on vertices forming the shape of the 3D object is encoded by a key framing method for performing deformation of the 3D object, the encoding method comprising steps of:

(a) extracting keys indicating position of key frames on a time axis, key values indicating characteristics information of key frames, and relation information, by parsing node information of the 3D object;

(b) generating search start information of a Breadth First Search (BFS) for defining spatial data correlation among vertices of the 3D object;

(c) generating vertex connectivity information from the related information extracted in step (a) and the search start information generated in step (b);

(d) quantizing the keys and key values;

(e) generating differential values of each of quantized keys of which temporal data redundancy is removed, and quantized key values of which spatiotemporal data redundancy is removed, based on the vertex connectivity information;

(f) receiving the differential values and generating the quantization steps of encoding bits of the key values; and

(g) receiving the quantization steps of encoding bits and removing redundancy among bits in the quantized values.

23. The encoding method of claim 22, wherein in step (a) node information is divided to a Coordinate Interpolator (CI) node and an IndexFaceSet (IFS) node, and field data formed with keys and key values are extracted from the CI node and Coordinate Index (CIdx) field data is extracted from the IFS node

24. The encoding method of claim 22, wherein step (b) comprises the steps of:

(b1) obtaining the numbers of vertices connected to each of the vertices in response to connection information among vertices to be encoded;

(b2) obtaining the index of a vertex which has the largest number of connected vertices among the numbers of vertices; and

(b3) generating the vertex of the obtained index as the search start information.

25. The encoding method of claim 22, wherein step (f) comprises the steps of:

(f1) comparing a maximum value and a minimum value for each of the X, Y, and Z coordinates forming the quantized key values;

(f2) if the absolute value of the minimum value is less than or equal to the maximum value in each of the X, Y, and Z coordinates, outputting the quantization step of encoding bits as ;

(f3) if the absolute value of the minimum value is greater than the maximum value in each of the X, Y, and Z coordinates, outputting the quantization step of encoding bits as .

26. The encoding method of claim 22, wherein in step (g) redundancy among bits is removed with respect to the probability of symbol occurrence.

27. The encoding method of claim 22, wherein the bit stream obtained by the encoding method comprises:

header information having the quantization size of the key values, the quantization step of encoding bits of X coordinates of the key values, the quantization step of encoding bits of Y coordinates of the key values, the

quantization step of encoding bits of Z coordinates of the key values, the minimum values and maximum values which are used in normalizing differential values from the quantized keys and key values to values between 0 and 1 inclusive; and

key value information according to the BFS search order.

28. An encoding apparatus of deformation information of a 3-Dimensional (3D) object, in which information on vertices forming the shape of the 3D object is encoded by a key framing method for performing deformation of the 3D object, the encoding apparatus comprising:

a field data input unit for extracting keys indicating position of key frames on a time axis, key values indicating characteristics information of key frames, and relation information, by parsing node information of the 3D object;

a vertex connectivity processing unit for generating vertex connectivity information from the related information;

an Adaptive Differential Pulse Code Modulation (ADPCM) processing unit for generating differential values for each of the keys from which temporal data redundancy is removed, and key values from which spatiotemporal data redundancy is removed, based on the related information and the vertex connectivity information;

a quantization unit for quantizing the differential values and outputting the quantized values; and

an entropy encoding unit for receiving the quantized keys and key values and removing redundancy among bits.

29. An encoding apparatus of deformation information of a 3-Dimensional (3D) object, in which information on vertices forming the shape of the 3D object is encoded by a key framing method for performing deformation of the 3D object, the encoding apparatus comprising:

a field data input unit for extracting keys indicating position of key frames on a time axis, key values indicating characteristics information of key frames, and relation information, by parsing node information of the 3D object;

a quantization unit for quantizing the keys and key values;

an Adaptive Differential Pulse Code Modulation (ADPCM) processing unit for generating differential values of the quantized keys from which temporal data redundancy is removed, and differential values of the quantized key values from which spatiotemporal data redundancy is removed, based on the related information and the vertex connectivity information;

an entropy encoding unit for removing redundancy among bits.

30. The encoding apparatus of any one of claims 28 and 29, wherein the field data input unit comprises:

a parse for dividing node information into a Coordinate Interpolator (CI) node and an IndexFaceSet (IFS) node; and

a demultiplexer for extracting field data formed with keys and key values from the CI node, and extracting Coordinate Index (CIdx) field data from the IFS node.

31. The encoding apparatus of claim 30, wherein the vertex connectivity processing unit receives the CIdx field data extracted from the IFS node as the related information and forms Breadth First Search (BFS) information for defining spatial data correlation among vertices as the vertex connectivity information.

32. The encoding apparatus of claim 31, wherein the vertex connectivity processing unit receives the CIdx field data, stores the CIdx field data in a queue for each vertex, and generates the BFS information based on whether or not each vertex is visited through the queue.

33. The encoding apparatus of any one of claims 28 and 29, wherein the ADPCM processing unit comprises:

a differential value generator for receiving the vertex connectivity information, coordinate information of the IFS node as the related information, and key values, and generating differential values among all position values of the key values change in a 3D space;

a predictor for extracting data redundancy in the differential values according to the spatial correlation among vertices based on the vertex connectivity information; and

Differential Pulse Code Modulation (DPCM) processors for DPCM processing each of keys, and key values of which data redundancy due to the spatial correlation is extracted.

34. The encoding apparatus of any one of claims 28 and 29, wherein the entropy encoding unit generates a bit stream from which redundancy among bits in the quantized values is removed using the probability of bit symbol occurrence.

35. The encoding apparatus of claim 34, wherein the bit stream is formed at least with encoded key information and key value information, the key information is formed with a combination of the keys and key indicators for the keys, the key value information is arranged in order of key in a key frame, and key frames are formed according to the search order of the vertex connectivity information.

36. An encoding apparatus of deformation information of a 3-Dimensional (3D) object, in which information on vertices forming the shape of the 3D object is encoded by a key framing method for performing deformation of the 3D object, the encoding apparatus comprises:

a field data input unit for extracting keys indicating position of key frames on a time axis, key values indicating characteristics information of key frames, and relation information, by parsing node information of the 3D object;

a vertex connectivity processing unit for generating vertex connectivity information from the related information;

a start vertex generator for determining a start vertex of the vertex connectivity information from the related information;

an Adaptive Differential Pulse Code Modulation (ADPCM) processing unit for generating differential values of each of keys of which temporal data redundancy is removed, and key values of which spatiotemporal data redundancy is removed, based on the vertex connectivity information;

a quantization unit for quantizing the differential values;

a quantization step generating unit for receiving the quantized keys and key values, and generating the quantization steps of encoding bits of X, Y, and Z coordinates of the quantized key values; and

an entropy processing unit for receiving the quantization steps of encoding bits of the X, Y, and Z coordinates, and removing redundancy among bits in the quantized values.

37. An encoding apparatus of deformation information of a 3-Dimensional (3D) object, in which information on vertices forming the shape of the 3D object is encoded by a key framing method for performing deformation of the 3D object, the encoding apparatus comprising:

a field data input unit for extracting keys indicating position of key frames on a time axis, key values indicating characteristics information of key frames, and relation information, by parsing node information of the 3D object;

a vertex connectivity processing unit for generating vertex connectivity information from the related information;

a start vertex generator for determining a start vertex of the vertex connectivity information from the related information;

a quantization unit for quantizing the keys and key values;

an Adaptive Differential Pulse Code Modulation (ADPCM) processing unit for generating differential values of the quantized keys of which temporal data redundancy is removed, and differential values of the quantized key values of which spatiotemporal data redundancy is removed, based on the vertex connectivity information;

a quantization step generating unit for generating the quantization steps of encoding bits of X, Y, and Z coordinates of the differentiated key values; and

an entropy processing unit for receiving the quantization steps of encoding bits of the X, Y, and Z coordinates, and removing redundancy among bits in the quantized values.

38. The encoding apparatus of any one of claims 36 or 37, wherein the field data input unit comprises:

a parse for dividing node information into a Coordinate Interpolator (CI) node and an IndexFaceSet (IFS) node; and

a demultiplexer for extracting field data formed with keys and key values from the CI node, and extracting Coordinate Index (CIdx) field data from the IFS node.

39. The encoding apparatus of claim 38, wherein the start vertex generator obtains the index of a vertex which has the largest number of connected vertices among the numbers of vertices connected to each of all vertices in response to the CIdx field data, and generates the vertex of the obtained index as the start vertex.

40. The encoding apparatus of claim 38, wherein the vertex connectivity processing unit receives the CIdx field data extracted from the IFS node as the related information, forms Breadth First Search (BFS) information for defining spatial data correlation among vertices as the vertex connectivity information, receives the start vertex information generated by the start vertex generator and generates BFS information by which search is performed from the start vertex.

41. The encoding apparatus of claim 38, wherein the quantization step generating unit comprises:

a maximum and minimum calculating unit for receiving the key values, data corresponding to the first key frame of the CI node, and the vertex connectivity information, and outputting maximum values and minimum values of the X, Y, and Z coordinates of the key values; and

a quantization step generator for generating the quantization steps of encoding bits enough to express the ranges of quantized data corresponding to the X, Y, and Z coordinates.

42. The encoding apparatus of claim 41, wherein the quantization step generator compares the maximum value and the minimum value of each of X, Y,

and Z coordinates data items input from the maximum and minimum calculating unit, and if the absolute value of the minimum value is less than or equal to the maximum value, outputs the quantization step of encoding bits as , and if the absolute value of the minimum value is greater than the maximum value, outputs the quantization step of encoding bits as .

43. The encoding apparatus of any one of claims 36 or 37, wherein the entropy processing unit removes the redundancy among bits in the quantized values, using the probability of bit symbol occurrence, and outputs the result as a bit stream.

44. The encoding apparatus of claim 43, wherein the bit stream comprises:

header information having the quantization size of the key values, the quantization step of encoding bits of X coordinates of the key values, the quantization step of encoding bits of Y coordinates of the key values, the quantization step of encoding bits of Z coordinates of the key values, the minimum values and maximum values which are used in normalizing differential values from the quantizing unit to values between 0 and 1 inclusive; and

key value information according to the BFS search order.